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Nonoperative Management of Herniated Cervical Intervertebral Disc With Radiculopathy

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Study Design. A longitudinal cohort study design was used. All patients underwent a systematically and uniformly applied treatment program with increasing intervention as further pain control was needed. All patients were followed up by questionnaire evaluating function and symptoms.

Objectives. The role of surgical *versus* nonsurgical treatment of patients with cervical disc herniation has not been adequately studied. The majority of published data reflects surgical outcomes, with little available data regarding the outcome of nonoperatively treated patients. Frequently, these patients are treated surgically if they have neurologic loss or radiculopathy that persists after rest or minimal intervention. In the authors' clinic, patients with cervical herniated nucleus pulposus and radiculopathy are treated with an aggressive physical rehabilitation program.

Summary of Background Data. All patients treated by the authors during a specified time period with a clearly defined diagnosis of cervical herniated nucleus pulposus were evaluated for outcome.

Methods. Twenty-six consecutive patients with cervical herniated nucleus pulposus and radiculopathy were evaluated by an investigator other than the treating physician. The follow-up time was more than 1 year in all patients. Data analyzed included symptom level, activity and function level, medication and ongoing medical care, job status, and satisfaction. Inclusion criteria included a focal cervical disc protrusion of less than 4 mm identified on magnetic resonance imaging and a major complaint of extremity pain compatible with cervical radiculopathy. Exclusion criteria included severe central canal stenosis, symptomatic cervical myelopathy, or condition that precluded participation in the rehabilitation program. Management consisted of traction, specific physical therapeutic exercise, oral anti-inflammatory medication, and patient education. The majority of patients presented with neurologic loss.

Results. Twenty-four patients were successfully treated without surgery. Twenty patients achieved a good or excellent outcome, of these 19 had disc extrusions. Two patients underwent cervical spine surgery. Twenty-one patients returned to the same job. One patient retired.

Conclusion. Many cervical disc herniations can be successfully managed with aggressive nonsurgical treatment (24 of 26 in the present study). Progressive neurologic loss did not occur in any patient, and most patients were able to continue with their preinjury activities with little limitation. High patient satisfaction with nonoperative care was achieved on outcome analysis.
[Key words: cervical herniated nucleus pulposus, cervical radiculopathy, nonoperative treatment] **Spine 1996; 21:1877–1883**

The efficacy of management for cervical radiculopathy resulting from intervertebral disc herniation by nonoperative measures has received limited attention. Although a less common entity than lumbar disc herniation, cervical intervertebral disc herniation is more frequently managed surgically on a case-by-case basis. Typically, the decision to proceed with surgical intervention is made when a patient has significant extremity or myotomal weakness, severe pain, or pain that persists beyond an arbitrary "conservative" treatment period of 2–8 weeks.[1,10,12,15] For nonvalidated reasons, cervical disc extrusions have been frequently considered a definite indication for surgery.[1,5,7,14] This approach may stem from a fear of disc fragment migration[14] or as an extrapolation of the conclusion of the Spangfort study regarding lumbar disc extrusion to the cervical spine.[18]

Nonsurgical management often consists of rest, a cervical collar, oral corticosteroid "dose-packs," nonsteroidal anti-inflammatory drugs (NSAIDs), and nonspecific physical therapy measures.[4–6,10,12,15,16,24] Surgical intervention is most frequently approached via an anterior discectomy with or without interbody fusion.[1,7] Less frequently, a posterior approach has been used.[1,7] The results of these surgical procedures have been described in numerous reports of a series of patients with spondylitic and discogenic radiculopathy, with reported success rates ranging 70–96%.[1–7,10,12,15,16,24] There are not adequate data currently in the medical literature to allow a comparison of nonsurgical treatment methods with surgical treatment for patients with cervical herniated nucleus pulposus (CHNP) and radiculopathy.[8,13,21] There are limited published reports of patients with CHNP treated nonsurgically.[9,13] Lees and Turner[11] have reported that if the symptoms of cervical spondylitic radiculopathy are persistent, the prognosis is considered guarded based on their observational study.

The purpose of the present study was to determine if patients with cervical herniated discs with radiculopathy

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could be effectively treated with a systematically applied program of nonsurgical treatment. The outcome of symptom resolution, function, and patient satisfaction in a longitudinal cohort of CHNP patients with a major complaint of extremity pain who met the time-honored standards for surgical intervention were evaluated (myelopathy was an exclusion criterion). Additionally, the authors wanted to gain insight into whether patients with extruded cervical discs could be treated effectively without surgery.

■ Materials and Methods

Patients with CHNP and radiculopathy seen by the two senior authors during a 2-year period beginning January, 1990, were considered for follow-up evaluation. Strict and specific inclusion and exclusion criteria had to be met for the patient to be considered for evaluation. These criteria were established to clearly identify the study population by the sole clinicopathologic entity of cervical disc herniation with radiculopathy. A minimum follow-up period of 1 year from the onset of treatment was required.

Inclusion Criteria. The patient must have had an magnetic resonance imaging (MRI) scan that demonstrated evidence of a CHNP on the independent reading of the radiologist and one of the two senior authors. All disc herniations considered for the present study extended at least 4 mm from the margin of the parent disc space. A contained HNP was defined as a focal extension of the disc of a minimum 4 mm and contained behind the posterior longitudinal ligament (PLL) or outer anulus. An extrusion was defined as nuclear material that extended beyond the confines of the outer anulus and PLL and was observed on at least two contiguous sequential axial slices and noted on sagittal slices to extend above or below the level of the disc space. There needed to be complete agreement among the authors and radiologists on the findings to classify a HNP as contained or extruded and on the size minimum for the patient to be included in the study.

All patients had a primary complaint of arm pain corresponding to the dermatomal or myotomal radicular distribution of the index disc noted to be abnormal on their MRI study.

Exclusion Criteria. Patients were excluded from the study group if they had underwent previous surgery on the cervical spine or had focal severe central spinal stenosis at or contiguous to the level of the HNP (defined as loss of cerebral spinal fluid reserve anterior and posterior to the cervical spinal cord, or central canal diameter < 12 mm). Patients were excluded if they had clinical findings of myelopathy or other central nervous system injury. Patients must have complied with follow-up guidelines of the nonoperative treatment program.

Management Program. Initial management consisted of physical and pharmacologic pain control measures applied in a sequential manner to allow successful participation in the rehabilitation program. Pain control measures were used sequentially based on level of intervention and success or failure with the preceding level of intervention. All patients were treated with ice, relative rest, a hard cervical collar worn for up to 2 weeks in a position to maximize arm pain reduction (all patients), NSAIDs for 6–12 weeks, manual and mechanical traction in physical therapy, followed by home cervical traction (all patients), and progressive strengthening exercises of the shoulder girdle and chest with training in postural control and body mechanics training. Twenty-two patients whose pain was inadequately controlled by the previously mentioned regimen were treated with a single week course of a moderate dose of oral prednisone, maximum 60 mg per day for 3 days, followed by rapid taper when adequate control of symptoms did not allow them to progress in the physical exercise training. Nine patients did not achieve adequate symptom control with these measures and were given a single, radiographic-guided epidural or selective nerve corticosteroid injection (nine patients). Residual symptoms after either corticosteroid treatment were managed with a six-session course of acupuncture and transcutaneous electrical nerve stimulation for 4 weeks in eight patients.

A physical rehabilitation program was used for all patients, including instruction in body mechanics and adaptation of the basic and advanced activities of daily living and occupation to proper cervical spine mechanics. This program was initiated progressively as pain control was achieved with the aforementioned measures. A specific upper and lower body strength and endurance and posture program was used as well as cervicothoracic spine stabilization training.[21] The duration of this portion of the program was 3 months, at which time the patient was discharged to an independent exercise program. Forceful joint manipulation was not used.

All consecutive patients with a diagnosis of CHNP seen during the study period were followed with evaluation by questionnaire, which assessed symptoms, function, satisfaction with outcome, additional use of medication, and additional medical and surgical treatment. Telephone interviews were conducted to complete and review the questionnaire with patients whose mailed questionnaire was incomplete or not returned in a timely manner (seven patients). In all patients, the review and assessment was done by an independent observer who was not involved as a treating physician (Figure 1).

Outcome Assessment.

Excellent: no limitations in activities, no pain, fully satisfied with outcome.

Good: minimal limitations in activity level, minor pain complaints of neck pain only, fully satisfied with outcome.

Fair: minor activity limitations (restriction from the most strenuous activities), minor complaints of neck and occasional extremity pain.

Poor: major activity limitations, persistent marked pain in the neck or arm.

■ Results

Twenty-eight patients met the inclusion and exclusion criteria and were enlisted for follow-up evaluation. Twenty-six patients returned the questionnaire or completed the questionnaire through telephone interview and comprised the study population. The remaining two patients could not be located at a current address or telephone number. Twenty-four patients were able to

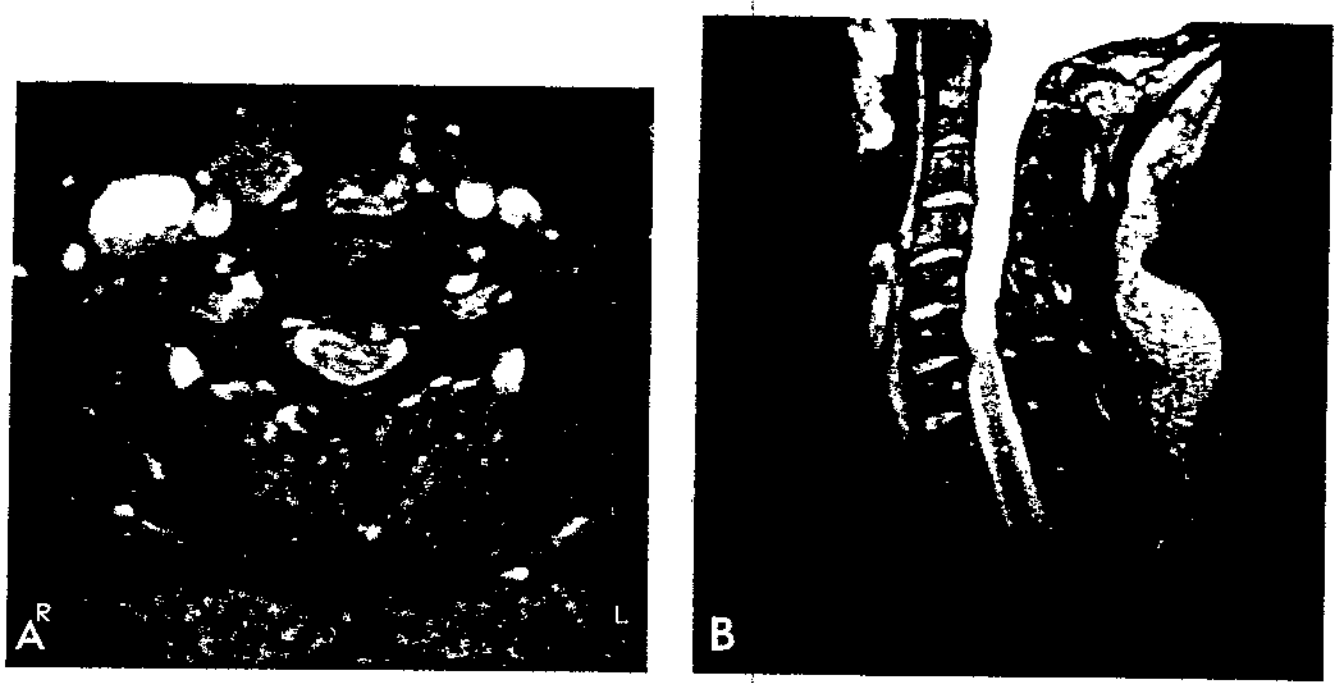

Figure 1. A, A 37-year-old woman with moderate left C6–C7 herniated nucleus pulposus with initial neurologic findings of 3/5 strength in left triceps. Axial gradient echo image through the C6–C7 disc space. B, Sagittal view of patient in *A*.

complete the nonoperative treatment program. The population of patients ranged in age from 22–58 years, with a mean age of 43.1 years (± 2.7 years). The mean follow-up period was 2.3 (± 0.3) years (range, 1.2–3.1 years).

All study patients met the inclusion criteria and had clearly defined CHNP on MRI. As defined in the inclusion criteria, 20 patients had extruded discs, and six of 26 patients had contained disc herniations. One extruded disc patient and one contained disc patient were not able to complete the nonoperative program and were treated surgically. The remainder of these results describe the patients who were able to complete the nonoperative program. Fourteen patients had multilevel degenerative changes and a defined CHNP at a single level. No patients had severe central canal stenosis. All of the patients with multilevel degenerative changes had some degree of stenosis, but none was severe (as defined in the inclusion criteria).

All patients had a predominance of radicular upper extremity pain as their chief complaint. Twenty of the 24 nonoperative patients had objective neurologic loss (83%). Fourteen had a motor loss of at least 4/5 (one grade of loss) on the medical research council (MRC) scale in the myotomal distribution of the segmental level of the index disc herniation. Six of the nonoperative patients had a sensory loss in the dermatomal distribution of the segmental level of the index disc herniation. The four patients with arm pain and no neurologic deficit had radicular referral zone pain in the distribution of the segmental level of the index disc herniation.

Work Status

Twenty-two of 24 nonoperatively treated patients returned to full work duties (92%). Twenty-one of 24 patients returned to the same job as before their injuries (88%). One patient retired, and one patient is working part-time. Both of these patients changed their occupational situation because of nonmedical factors.

Outcome

Twenty of 24 nonoperative patients had a good or excellent outcome, which represented 83% of the nonoperative treatment group. Eighty-nine percent of the nonoperative patients with disc extrusions achieved a good or excellent outcome. Eighty percent of the patients with contained disc herniations achieved a good or excellent outcome. Four patients reached a fair outcome. Three of these patients had some component of central canal stenosis. No patients had progressive neurologic loss or reached a neurologic catastrophe (*i.e.*, new onset of myelopathy). The four patients with a fair outcome had multilevel degenerative changes. All patients with motor loss reached clinical neurologic improvement (*i.e.*, resolved their neurologic deficit). No patients achieved an outcome in the poor category (Figure 2 and Tables 1–6).

■ Discussion

The traditional approach to symptomatic cervical disc herniation with radiculopathy has been rest, analgesics, and surgery, if the former measures do not result in symptom reduction. The results of surgery have been

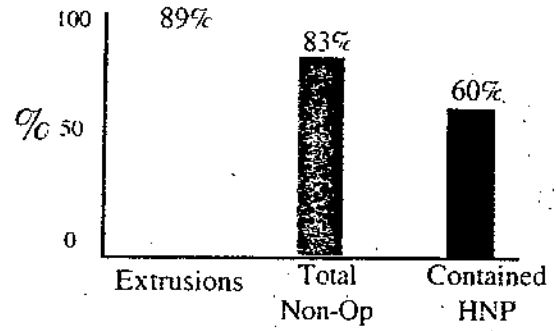

Figure 2. Good and excellent outcomes.

considered to be so successful that there appears to be limited resistance to rapid surgical intervention.[1,2,4–7,10,12,15,16,23] In the present study, a cohort of patients with clearly defined diagnostic criteria for symptomatic cervical disc herniation were evaluated longitudinally for outcome in functional level, symptoms, and satisfaction. These criteria were chosen to establish reasonable internal validity and to aid comparison of previous surgical studies of the same clinicopathologic condition of cervical disc herniation with radiculopathy. Any patients with myelopathy were excluded. The results of a systematically applied program of nonoperative treatment, as in the present study population, had patient outcome results equivalent to results of similar patients treated surgically. Although some surgical investigators reported good or excellent functional outcomes at rates of 96%,[4] other investigators using similar surgical procedures reported success rates equivalent to the present nonoperatively treated cohort.[1,2,6,7,12] Few of these surgical papers had independent reviewers, (*i.e.*, someone other than the treating physician) evaluating the patient outcomes. The study by Herkowitz et al[7] involved prospective evaluation of patients with soft cervical disc herniations comparing anterior *versus* posterior surgical approaches. This study featured a similar frequency to the present study group of cervical disc HNP with good or excellent outcomes (16 of 17 in the Herkowitz study compared with 16 of 19 in the present study).[7] In the study by Bohlman et al, a 93% good or excellent rate is noted. However, the study population was heterogeneous, including spondylitic radiculopathy resulting from central and lateral stenosis and a subset of cervical HNP patients in whom the outcome was not separately assessed. Although nonoperative treatment in the patients in the present study averaged 9 months, it was not systematically or algorithmically applied as in Bohlman et al's study and did not include aggressive pain and inflammation control with corticosteroids. The follow-up assessment was carried out by one of the treating investigators.

Cervical disc herniation with extrusion is frequently managed surgically because of fear,[14] of fragment migration or injurious compression of nerve root or spinal cord elements resulting in worsening, or paralytic type of neurologic injury. It is important to note that in this nonoperatively treated group, there were no patients who suffered either of these complications. The complication rates of surgical intervention range from 0% to 7% and include donor graftsite pain, dysphasia, and neurologic injury.[5]

The inclusion criteria for this study arbitrarily defined a contained CHNP as a 4-mm focal extension of the disc contour. This definition is consistent with the definitions used in the surgical literature for treatment of the same patient population. To date, there is no clearly defined pathologic correlation studies comparing MRI findings with the type of HNP as described by the authors. However, the definitions the authors used in the inclusion criteria are the prevailing definitions currently in clinical use. Similarly, the definition of an extrusion by its extension beyond the confines of the PLL or above and below the disc space matches the common clinical descriptions of the entity. Although there is a lack of definitive tissue confirmation of this diagnosis, the definition as outlined allows a clean separation of the two types of disc herniations described herein (*e.g.*, extruded and contained).

The outcome questionnaire used in the present study is not a statistically validated instrument. However, at present there is no universally accepted and validated spine outcome instrument in use. When validated instruments become available, all spine research can be judged

Table 1. Total Number of Patients Studied

Total patients entered for follow-up evaluation	28
Total patients studied	26
Male	15
Female	11
Total nonoperative patients	24
Age (yr)	
Mean	43.1 ± 2.7
Range	22–58
Follow-up period (yr)	
Mean	2.3 ± 0.3
Range	1.2–3.1

Table 2. Disc Morphology (Nonoperative Patients)

Disc Morphology	Number of Patients
Disc extrusions	19
Contained disc herniations	5
Multilevel degenerative changes	14

Table 3. Neurologic Status

Neurologic Loss	Number of Patients
Motor loss (one grade of loss MRC scale)	14
Sensory loss	6
Long tract signs	0

MRC = Medical Research Council

Table 4. Work Status of Nonoperative Treatment Group

Work Status	Number of Patients (%)
Returned to work full time	22 (92)
Returned to same job	21 (87.5)
Retired	1

by the same measuring stick. The authors used a patient satisfaction scale and an independent reviewer to collect patient outcome data, which was an attempt to remove treating physician bias and insulate the results from the physician's perception of outcome.

One may argue that the present study population represents a subgroup of patients with CHNP who responded to nonsurgical treatment. However, the present group represents a consecutive group of patients, many of whom had been deemed nonoperative treatment failures by surgeons who had evaluated these patients and recommended surgery. It would be highly unlikely that all of the present patients represented a single subgroup that responded differently than the CHNP population as a whole.

This present study represents a consecutively identified group of patients with clearly defined HNP and radicular symptoms. The patients' symptoms correlated with the level of disc herniation in all cases. These outcome results are superior to what has been previously reported as the "natural history" of similar patients who are not treated (83% *vs.* 60%). It would be erroneous to assume that the nonoperative treatment did not improve on the natural history of the condition. However, the small subgroup in the present population with a contained HNP and radiculopathy did not improve as much, 89% for extrusion patients *versus* 80% successful outcome for the contained HNP group. The contained HNP group consisted of only six patients and is an inadequate group size from which to draw any meaningful conclusions. This issue will require further study to resolve.

It could be argued that the surgical studies showed a higher rate of good or excellent results than in the present group of patients.[1,4,15] If the present group of patients who complete follow-up evaluation was analyzed and the patients who required surgery were considered nonoperative failures, the success rate was 17 of 20 (85%) (extruded discs), and four of six (67%) for contained disc herniation. This lowered extrapolation of this study's data still compares favorably to the surgical

Table 5. Nonoperative Treatment With Good/Excellent Results

Patient Population	Number (%)
Total population	20/24 (83)
Disc extrusions	17/19 (89)
Contained disc herniations	3/5 (60)

Table 6. Nonoperative Treatment With Fair Results—Extenuating Factors

Nonoperative Treatment With Fair Results	Number of Patients (%)
Multilevel disc disease	5 (100)
Moderate central canal stenosis	3 (60)
Regular medication usage stronger than acetaminophen	2 (40)

reported outcomes. It is essential to consider that a large percentage of the patients who underwent surgery may have reached the same outcome without requiring surgery. This dilemma is inherent in the interpretation of the results of studies that compare nonoperative and operative management, as described by Weber regarding his outcome of lumbar HNP.[22] His conclusion that 60% of patients treated surgically could have successfully achieved their outcome without surgery is overshadowed by the superficial conclusion that surgery is superior in the first year of follow-up evaluation.[22,23] A small percentage of patients with CHNP do require surgery for radiculopathy. However, the majority can be treated successfully with a carefully applied and progressive nonoperative program. Management need not be overly aggressive in exercise. It must, however, be attentive to continued efforts to progressively reduce the patient's pain and advance physical function through exercise.[21] Although the present study did not represent a randomized trial of this nonoperative program compared with placebo, these data represent a strong indication that the results of aggressive nonoperative treatment may be better than observation and natural history alone. It is important to note that the available results of surgical treatment of CHNP are based on nonrandomized case series.[1,2,4–7,12,15,16,20,24] The natural history of CHNP is favorable, as in lumbar disc herniation.[17,22] However, aggressive measures at pain and inflammation control can probably help a patient reach a favorable endpoint while suffering considerably less pain and enabling him or her to return to work.

To achieve pain control in most patients, NSAIDs and short-term narcotic analgesics may suffice. However, in the presence of significant radiculopathy, early intervention with corticosteroids, in the authors' experience, will result in a more rapid decrease in radicular symptoms. Inflammation of neural elements appears to play an important role in radiculopathy in the cervical spine as in the lumbar spine.[18] In patients in whom oral corticosteroids are ineffective or only partially effective, a selective epidural injection of soluble corticosteroid is an effective alternative. Further prospective study is necessary to clarify the role these injections should play in the management of cervical radiculopathy.

The mechanism of pain resolution from nonoperative management of a cervical herniated disc may be a similar process to that in the lumbar HNP. The radiculop-

athy caused by the disc herniation may result from neural inflammation[18] rather than from compression alone. The beneficial effect of corticosteroids may occur as a result of the anti-inflammatory properties of these drugs. If the inflammatory response can be controlled pharmacologically, the neural elements will adapt to the deformation caused by the disc material to which they were initially intolerant. At that point, the patient will be able to undergo progressively vigorous therapeutic physical exercise and improve his or her level of function.

In addition to the resolution of inflammation, the reabsorption of extruded disc material itself probably occurs in the cervical HNP as it does in the lumbar disc HNP.[8,13,17] The outcome data presented here in cervical HNP extrusion patients, combined with similar findings in the lumbar spine, support the concept that an extruded disc actually may have a more favorable nonoperative prognosis than contained disc pathology. Conceptually, this is consistent with the premise that contained disc pathology represents a distinct clinical entity pathophysiologically different than nuclear extrusion.

The components of the nonoperative treatment that may be specifically effective requires further investigation. In the future, a randomized prospective study of nonoperative management compared with a placebo control and surgery for patients with CHNP will be necessary. The present study made no attempt to determine which component or components of the nonoperative treatment plan that significantly impacted outcome favorably *versus* which ones that had limited or no benefit. It could be argued that the nonoperative treatment applied in this group was heterogeneous. Rather, nonoperative management was applied as an algorithm of progressive intervention if adequate pain control and resolution was not achieved by the preceding less invasive technique. For example, all patients who received an intraspinal injection were treated with oral corticosteroid medication first, which was used if physical treatment measures (tissue and joint mobilization, ice, electrical stimulation, traction, and use of a cervical collar) were inadequate to relieve and resolve pain to allow the patient to advance his or her level of physical function. Similarly, acupuncture was used for those patients with residual pain after oral medication and intraspinal injection. Transcutaneous electrical nerve stimulation units were used in those patients who responded to acupuncture but still had residual pain to allow further participation in a physical rehabilitation program. Until there is a randomized clinical trial comparing surgery and nonsurgical care, it is important to consider that aggressive nonoperative care is indicated in every cervical disc herniation patient before a decision for surgical intervention. Additionally, the presence of radicular neurologic loss or nuclear extrusion should not be used solely as the criterion for surgical intervention.

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Point of View

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The authors have conducted a retrospective review of the outcome of 26 consecutive patients treated nonoperatively who presented with radiculopathy and a cervical herniated nucleus pulposus (HNP) confirmed by magnetic resonance imaging (MRI). The treatment program consisted of anti-inflammatory medications, cervical traction, specific physical exercises, and patient education. Twenty-four patients were successfully treated without surgery, and at a mean follow-up period of 2.3 years, 20 patients achieved a good or excellent result. No patient developed progressive neurologic loss, and most patients recovered to their premorbid status.

In the 26 patients, the authors diagnosed a disc extrusion in 20 patients and a disc protrusion in six, and they attempted to correlate patient outcome to the type of disc herniation. Although a disc extrusion was defined as nuclear material extending beyond the confines of the outer anulus and posterior longitudinal ligament (PLL), it is not stated by the authors how the integrity of the outer anulus and PLL was determined on the MRI studies. In the lumbar spine, there has been an attempt to determine the integrity of these structures by assessing whether the dark peripheral line overlying the periphery of a disc herniation is intact. In the largest retrospective study assessing whether it is possible with MRI to determine the precise type of lumbar disc herniation, *i.e.*, protrusion *versus* extrusion, Silverman et al[2] concluded that MRI cannot reliably make this distinction.

type of cervical disc herniation, they justify their classification of disc protrusion *versus* extrusion on its prevailing clinical use. Considering that the authors are presenting important new observations that raise into question the prevailing therapeutic approach for patients with cervical disc herniations, they should not so readily accept the prevailing unproven MRI classification system for a cervical HNP. Using computed tomography, large cervical disc herniations have been shown to decrease in size to a greater extent than small herniations,[1] and perhaps the patients diagnosed with disc extrusions in Saal's study, who had a more favorable outcome, merely had larger herniations than patients with protrusions. Now that the authors have demonstrated the potential success of nonoperative care for a cervical HNP, it is even more important to try to determine if patient outcome can be predicted by the appearance of an HNP on the initial imaging study. Hopefully, we can create an MRI classification system for cervical disc herniation that is reliable and accurate, but this will require further investigative work.

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